REMARKS

In an Office Action dated April 11, 2003, the Examiner rejected claims 1-20 under 35 U.S.C. §112, second paragraph, as being indefinite; rejected claims 1 and 3-7 under 35 U.S.C. §103(a) as unpatentable over Kuramoto (JP1005759) in view of Wang et al. (US 5,447,466); rejected claims 2, and 8-20 under 35 U.S.C. 103(a) as unpatentable over *Kuramoto* and *Wang*, and further in view of Bajorek (US 6,363,559).

Indefiniteness Rejections

The Examiner objected to the use of the phrase "glass or ceramic". Applicants refer the Examiner to pages 8-9 of applicants' specification:

> ... The process of producing a disk substrate is described herein with respect to glass disk substrates, which at present is the material of choice. However, at least some ceramic materials or glass ceramic materials are also potentially suitable for use as substrates in disk drive storage devices, and the present invention is applicable to at least some such ceramic or glass ceramic materials. Certain ceramic or glass ceramic materials have properties which are potentially superior to glass, e.g., higher strength or higher temperature stability. The high cost of manufacture currently discourages use of such materials, but it is foreseeable that such materials may become employed in disk drives in the future, particularly if processes for reducing the cost of manufacture can be found. *As used herein, "glass or ceramic" shall include materials which are either glass or ceramic or some combination of glass and ceramic.* [emphasis added]

Applicants are entitled to be their own lexicographer, and it is clear from the above passage that the phrase "glass or ceramic" is used to encompass any material with is either glass or ceramic or some combination of the two. Applicants therefore believe that the claims as originally presented are sufficiently definite. However, since applicants are not trying to be coy, and are perfectly willing to repeat on the record that the phrase "glass or ceramic" means just what it says in the above passage, they are also willing, in the interests of furthering prosecution, to explicitly recite this understanding in the language of the independent claims. Accordingly, claims 1, 10 and 15 have been amended to recite that the disk substrate is of a material which is either glass or

ceramic or some combination thereof, and references to "glass or ceramic" have been removed accordingly. Applicants believe this amendment should resolve the Examiner's concerns about definiteness of the claims.[1]

Prior Art Rejections

Applicants respectfully traverse the prior art rejections of the claims herein.

Applicants' claims are directed to the manufacture of a specific, special-purpose article, i.e., a recording disk for a disk drive data storage device. Although millions of such articles have been manufactured, and they are commonplace throughout the world, few people really appreciate how remarkable they are. The demand to design data storage devices which are faster, smaller, more reliable, have greater data capacity, and are cheaper, and the enormous effort in research and development by various companies to satisfy this demand, has produced data storage devices which would have been viewed as nothing short of miraculous only a few short years ago. The disk itself, upon which data is recorded, is central to the design of any disk drive storage device, and either limits or enables almost any improvement that can be made to the device.

The competing design considerations and constrains for a recording disk are numerous. Ideally, the disk is perfectly flat and perfectly round. The disk should be lightweight to reduce spindle assembly inertia and facilitate faster acceleration to operating speed and lighter bearing loads. The disk should be strong enough to tolerate high rotational speeds, shock and vibration, and so forth. The disk should be thin to both reduce weight and to reduce the size of the disk drive, but if it is too thin it may warp or lack mechanical strength. The disk substrate material

---

[1] Through some oversight, the original claims sometimes reversed the order of the terms and referred to "ceramic or glass"; this was not intended to mean anything different from "glass or ceramic". Additionally, claim 15 at one point referred to "said glass disk substrate", when what was clearly meant was "glass or ceramic". The amendments have clarified these points.

should be non-magnetic (in the case of a rotating magnetic disk drive storage device) to avoid interference with the magnetically encoded data. And finally, the disk should be cheap, because it must be mass produced and sell at a price users will pay.

After years of experimentation and research, certain techniques for manufacturing recording disks have become predominant in the industry. Most disk substrates are of aluminum, and a set of well known processes exist for cutting, machining and polishing aluminum disk substrates for use in data storage devices. As design parameters have become more demanding, aluminum exhibits certain limitations. In particular, aluminum is not as strong as certain other materials. An alternative material to aluminum is glass. Glass provides greater mechanical strength, and, like aluminum, is non-magnetic and can be made to exacting tolerances necessary for use in disk drive devices. Unfortunately, an entirely new set of process steps is needed to manufacture a glass disk substrate, and these processes in general make the glass disk more expensive than aluminum. For this reason, glass disks have typically been used only in applications that have higher design requirements. For example, glass disks are typically used in portable laptop computers, because their greater mechanical strength makes them more tolerant of shock and vibration, whereas aluminum disks are typically used in fixed installations under less stressful conditions, such as offices or data processing centers.

Glass disks are typically cut, ground and polished in multiple steps to produce a finished shape. One set of processes produces a smooth finish on the recording surface, while another set of processes shapes and finishes the circumferential edges, the requirements for the edges being different from the requirements for the recording surfaces. In general, the grinding and polishing steps abrade material using progressively finer abrasives, to produce a smooth finished part. Glass disks are further chemically strengthened to improve the overall mechanical strength of the material.

In accordance with applicants' preferred embodiment, the circumferential edges of a disk substrate are finished by grinding in a ductile grinding regime. Ductile grinding of brittle materials is a known but rarely used phenomenon, in which a brittle material is removed using a form of shaving action with a substantially harder material. Ductile grinding requires specific grinding materials used under exacting conditions. Even where it is possible at all, it is likely to be substantially more expensive than conventional abrading processes.

Applicants reasoned that ductile grinding of the edges of a glass recording disk will greatly reduce the incidence fine surface fractures. These fractures appear to be the limiting factors in the overall mechanical strength of a thin glass disk. I.e., the failure mechanism for such a disk is propagation of fine surface fractures at the disk edges under certain stressful conditions. Chemical strengthening improves the strength of the finished part by retarding the growth of such fractures. Applicants further reasoned that chemical strengthening would be unnecessary if the incidence of fractures could be reduced in the first place, and their experimentation confirmed this hypothesis. Finally, use of non-chemically strengthenable glass (i.e., without ion dopants necessary for chemical strengthening) produces a superior recording disk, because dopants can leech out under certain conditions and interfere with operation. Such a superior disk has greater tolerance of extreme environmental conditions, and thus further pushes the basic design envelope of disk drive recording technology, which is ultimately dependent on the robustness of the disks themselves.

Kuramoto discloses edge grinding of a glass disk using conventional abrasive grinding technology,[2] and does not disclose finishing the edge of a glass recording disk by ductile grinding.

---

[2] *Kuramoto*'s English language abstract does not explicitly state whether *Kuramoto*'s glass disk is intended for use in a disk drive data storage device. For purposes of the present discussion, applicants assume that this is so. In any case, applicants concede that abrasive edge grinding of glass disks for use in disk drive data storage devices is known.

Wang discloses that ductile grinding is a known process for machining ceramic materials, but does not disclose the application of ductile grinding to edge finishing of glass recording disks.

Applicants' claim 1 recites production of a glass or ceramic data storage disk by ductile grinding of the circumferential edge. The Examiner reasons that it would have been obvious to combine *Wang* and *Kuramoto*, since *Wang* discloses ductile grinding as a finishing process for ceramic materials, and *Kuramoto* discloses finishing of glass disk edges.

As seductive as this argument is, applicants submit that it is incorrect. In order to support a combination of references, there must be some motivation or suggestion in the art to combine the references in the manner claimed by applicant. The present application is a classic illustration of the principle, for such a motivation or suggestion is utterly lacking.

There are potentially hundreds or thousands of possible processes and variations of processes for shaping material and treating surfaces, many of them existing only in theory or in laboratory experiments.. Applicants ask, is it really "obvious" to try each and every one of these for any given special-purpose application? This can not be the case. At the very least, there must be a suggestion, somewhere, that a particular process would be useful for the purpose.

As the *Wang* reference acknowledges, ductile grinding is a "limited use" process for "special applications", heretofore without "commercial significance". In other words, while it is a known phenomenon, it is little more than a laboratory curiosity. It is significantly more expensive than conventional processes, and unless some reason can be offered for using ductile grinding, there is no motivation to do so.[3]

---

[3] Although use of ductile grinding makes it possible to eliminate chemical strengthening and thus remove a process step, it is unclear whether the cost savings from removing the chemical strengthening step alone are sufficient to offset the increased cost of ductile grinding over conventional finishing steps. Applicants believe that the real benefit

It is easy enough to say that the reason for using ductile grinding is to avoid chemical strengthening, and to produce a superior finished disk. But where is this motivation shown in any of the cited art? It is applicants' disclosure that makes this observation, and the Examiner's combination of *Wang* and *Kuramoto* is based on hindsight from applicants' disclosure. For all these reasons, the Examiner's rejection of claim 1 was erroneous.

Claims 10 and 15 recite the production of a glass or ceramic data storage disk without chemical strengthening. For essentially the same reasons, these claims are also patentable. As explained above, data storage disks are specialty devices, subject to unusual stresses. Process steps sufficient for finishing ordinary glass articles are not necessarily sufficient for making data storage disks. Conventional glass data storage disks are produced by chemical strengthening to provide sufficient mechanical strength. It is mere hindsight to say that such a step is unnecessary, provided one uses some sufficiently gentle process which does not produce cracks at the edges. Conventional processes, which are the result of considerable research and development, do produce such cracks, and no suggestion has been shown in the art to use a process such as applicants', which does not.

The remaining secondary reference, *Bajorek*, is cited to show use of a magnetic coating and installation in a rotating magnetic disk drive storage device, but does not contain the critical suggestion to use ductile grinding or some equivalent process to avoid chemical strengthening of the edges.

In view of the foregoing, applicants submit that the pending claims are now in condition for allowance and respectfully request reconsideration and allowance of all claims. In addition,

---

would be in the production of a higher quality product with fewer cracks and without ion dopants.

the Examiner is encouraged to contact applicants' attorney by telephone if there are outstanding issues left to be resolved to place this case in condition for allowance

Respectfully submitted,

JAMES A. HAGAN, et al.

By:____________________
Roy W. Truelson
Registration No. 34,265

Telephone: (507) 289-6256